CALTRANS
ENCROACHMENT PERMITS

GUIDELINES AND SPECIFICATIONS

FOR

HORIZONTAL DIRECTIONAL DRILLING INSTALLATIONS

EFFECTIVE JANUARY 1, 2000, LOCATING AND TRACKING OF THE REAMER DURING THE BACK-REAMING PROCESS IS REQUIRED.

California Department of Transportation
Headquarters Office of Encroachment Permits

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GUIDELINES FOR HORIZONTAL DIRECTIONAL DRILLING TECHNOLOGY

HDD GUIDELINES & SPECIFICATIONS

PERMIT APPLICATION SUBMITTAL

The permit application package submittal should contain the following information in support of the permit application.

1. Location of entry and exit point.
2. Equipment and pipe layout areas.
3. Proposed drill path alignment (both plan & profile view).
4. Location, elevations and proposed clearances of all utility crossings and structures.
5. Proposed Depth of cover.
6. **Soil analysis.
7. Product material (HDPE/steel), length, diameter-wall thickness, reamer diameter.
8. Detailed pipe calculations, confirming ability of product pipe to withstand installation loads and long term operational loads including H20.
9. Proposed composition of drilling fluid (based on soil analysis) viscosity and density.
10. Drilling fluid pumping capacity, pressures and flow rates proposed.
11. State right-of-way lines, property, and other utility right-of-way or easement lines.
12. Elevations.
13. Type of tracking method/system.
14. Survey Grid establishment for monitoring ground surface movement (settlement or heave) due to the drilling operation.

Note: ** *May be waived by the District Permit Engineer on HDD jobs of less than 200mm (6") in diameter and on a transverse crossing less than 150' in length.*

ADDITIONAL PERMIT CONDITIONS SHALL BE SET FORTH IN THE SPECIAL PROVISIONS OF THE PERMIT.

The following, outlines recommended depths for various pipe diameters:

RECOMMENDED MINIMUM DEPTH OF COVER	
DIAMETER	**DEPTH OF COVER**
50mm (2 inches) to 150mm (6 inches)	1.2 meters (4 feet)
200mm (8 inches) to 350mm (14 inches)	1.8 meters (6 feet)
375mm (15 inches) to 600mm (24 inches)	3.0 meters (10 feet)
625mm (25 inches) to 1200mm (48 inches)	4.5 meters (15 feet)

Upon completion of the work, the permittee shall provide an accurate as-built drawing of the installed pipe.

SOIL INVESTIGATIONS

A soil investigation is required, suitable for the proposed complexity of the installation to confirm ground conditions that will be encountered during the HDD operation. The HDD process is in itself a continual and extensive soil analysis as the pilot bore is made and encountering the varying soils and formations.

The purpose and intent of the soil analysis is to assist the contractor in developing the proper drilling fluid mixture, and to ensure that the contractor is aware of the conditions that exist in the area of the proposed project. This prepares the contractor in the event they should encounter a zone of pre-tectonics, and that they would need additives or preventive measures in dealing with inadvertent returns (frac-outs).

Determination of Soil Investigations

The District Permit Engineer (DPE) should determine the extensiveness of the Soil Investigation to be performed based on the complexity of the HDD operation, the DPE may recommend according to the guidelines listed below, a combination of, or modify the guideline to fit the respective area:

Projects less than 500' in length, where the product or casing is 8" or less in diameter:

A field soil sampling investigation to a depth of one foot below the proposed drilling.
a) subsurface strata, fill, debris and material

Projects less than 800' in length, where the product or casing is 14" or less in diameter:

A field soil sampling investigation to a depth of one foot below the proposed drilling.
a) subsurface strata, fill, debris and material
b) particle size distribution (particularly percent gravel and cobble)

Projects where the product or casing is 16" or greater in diameter:

A geotechnical evaluation by a qualified soil engineer to determine the following.
a) subsurface strata, fill, debris and material,
b) particle size distribution (particularly percent gravel and cobble),
c) cohesion index, internal angle of friction, and soil classification,
d) plastic and liquid limits (clays), expansion index (clays), soil density
e) water table levels, and soil permeability,

Projects where the product or casing 24" or greater in diameter:

A geotechnical evaluation by a qualified soil engineer to determine the following.
a) subsurface strata, fill, debris and material
b) particle size distribution (particularly percent gravel and cobble)
c) cohesion index, internal angle of friction, and soil classification
d) plastic and liquid limits (clays), expansion index (clays), soil density, and penetration tests,
e) rock strength, rock joint fracture and orientation, water table levels, and soil permeability,
f) areas of suspected and known contamination should also be noted and characterized.

Highway crossings: a borehole or test pit should be undertaken on both sides and in the median when conditions permit. Additional bore-holes or test pits should be considered if substantial variation in soil conditions are encountered in the soil analysis (the presence of gravel, cobble, and/or boulders).

Fluid jetting methods used as a means of cutting **should only be considered** where soils have a high cohesion such as stiff clays.

PRE-CONSTRUCTION & SITE EVALUATION

The following steps should be undertaken by the permittee/contractor in order to ensure safe and efficient

construction with minimum interruption of normal, everyday activities at the site.

1. Notify owners of subsurface utilities along and on either side of the proposed drill path of the impending work through USA alert (the one-call program). All utilities along and on either side of the proposed drill path are to be located.
2. Obtain all necessary permits or authorizations to carry construction activities near or across all such buried obstructions.
3. All utility crossings should be exposed using a hydro-excavation, hand excavation (potholing) or other approved method to confirm depth.
4. Construction schedule should be arranged so as to minimize disruption (e.g. drilling under railroad beds, major highways, and/or river crossings).
5. The proposed drill path should be determined and documented, including its horizontal and vertical alignments and the location of buried utilities and substructures along the path.

Walk the area prior to the commencement of the project and visually inspect potential sites. The following should be addressed:

1. When on State R/W establish whether or not there is sufficient room at the site for: entrance and exit pits; HDD equipment and its safe unimpeded operation; support vehicles; fusion machines; stringing out the pipe to be pulled back in a single continuous operation.
2. Establishing suitability of soil conditions for HDD operations. Subgrade soils consisting of large grain materials like gravel, cobble, and boulders make HDD difficult to use and may contribute to pipe damage.
3. Check the site for evidence of substructures such as manhole covers, valve box covers, meter boxes, electrical transformers, conduits or drop lines from utility poles, and pavement patches. HDD may be a suitable method in areas where the substructure density is relatively high.

INSTALLATION REQUIREMENTS

During construction continuous monitoring and plotting of pilot drill progress shall be undertaken to ensure compliance with the proposed installation alignment and allow for appropriate course corrections to be undertaken that would minimize “dog legs” should the bore start to deviate from the intended bore path.

Monitoring shall be accomplished by manual plotting based on location and depth readings provided by the locating/tracking system or by computer generated bore logs which map the bore path based on information provided by the locating/tracking system. Readings or plot points shall be undertaken on every drill rod.

Excess drilling fluids shall be contained at entry and exit points until recycled or removed from the site. Entry and exit pits should be of sufficient size to contain the expected return of drilling fluids and soil cuttings.

The permittee shall ensure that all drilling fluids are disposed of in a manner acceptable to the appropriate local, state, or federal regulatory agencies. When drilling in contaminated ground the drilling fluid shall be tested for contamination and disposed of appropriately. Restoration of damage to any highway or non-highway facility caused by escaping (“fracout”) drilling fluid, or the directional drilling operation, shall be the responsibility of the permittee.

To minimize heaving during pullback, the pull back rate shall be determined which maximizes the removal of soil cuttings and minimizes compaction of the ground surrounding the borehole. The pullback

rate shall also minimize overcutting of the borehole during the back reaming operation to ensure excessive voids are not created resulting in post installation settlement.

The permittee shall, prior to and upon completion of the directional drill, establish a Survey Grid Line and provide monitoring as outlined in their submitted detailed monitoring plan. Subsurface monitoring points shall be utilized to provide early indications of settlement as large voids may not materialize during drilling due to pavement bridging.

Should pavement heaving or settlement occur, sawcutting and replacement of the asphalt shall be the responsibility of the permittee.

To prevent future settlement should the drilling operation be unsuccessful the permittee shall ensure the backfill of any void(s) with grout or backfilled by other means.

PERMITTEE/CONTRACTOR RESPONSIBILITIES

The permittee/contractor should provide the following items: construction plan; site layout plan; project schedule; communication plan; safety procedures; emergency procedures; company experience record; contingencies plan and drilling fluid management plan.

CONSTRUCTION PLAN REQUIREMENTS

The permittee shall identify in the construction plan:

1) location of entry and exit pits.
2) working areas and their approximate size.
3) proposed pipe fabrication and layout areas.
4) state right-of-way lines, property lines.
5) other utility right-of way and easement lines.
6) pipe material and wall thickness.
7) location of test pits or boreholes undertaken during the soil investigation.
8) identify the proposed drilling alignment (both plan & profile view) from entry to exit.
9) identify all grades and curvature radii.
10) all utilities (both horizontal and vertical).
11) structures with their clearances from the proposed drill alignment.
12) confirm the minimum clearance requirements of affected utilities and structures.
13) required minimum clearances from existing utilities and structures.
14) diameter of pilot hole, number and size of pre-reams/backreams.
15) Access requirements to site (if required).
16) crew experience.
17) Type of tracking equipment.

LOCATING AND TRACKING

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The permittee shall provide the method of locating and tracking to be used during the boring operation (walkover, wireline, or wireline with wire surface grid).

Illustration **2.2A** below shows a universal housing that will work with any drill-string on all HDD rigs.

This housing can be utilized in the initial pilot bore, after exiting, the cutting head can be removed and the reamer installed.

This housing chamber can utilize any of the sonde batteries manufactured, regardless of manufacturer.

There is also a 2.5" mini-sonde combination available for smaller rigs.

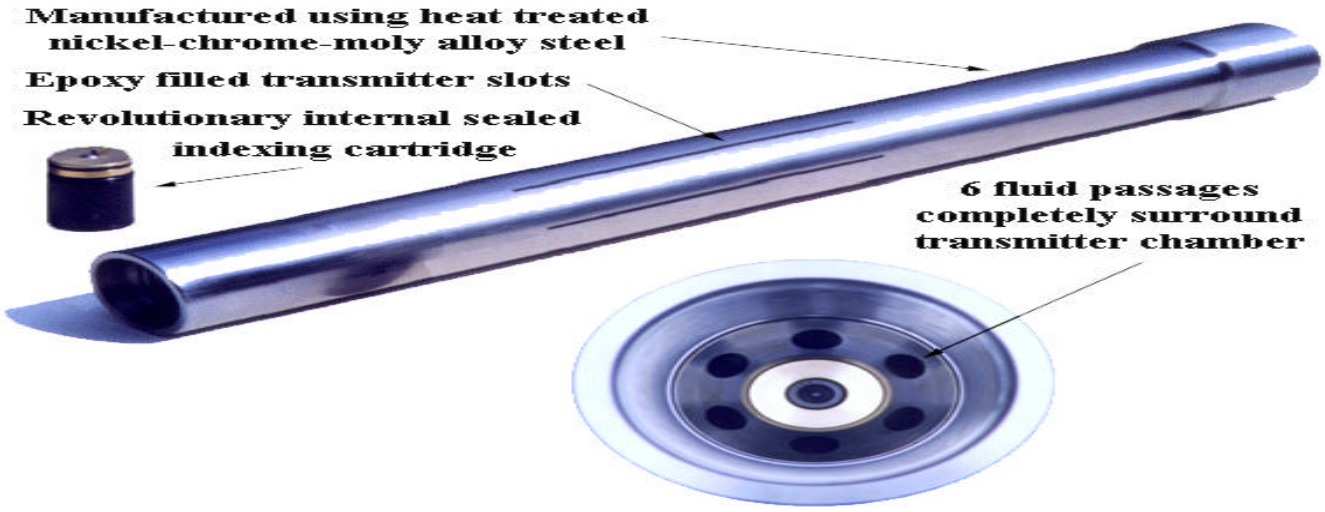

ILLUSTRATION 2.2A

Drilling Fluids Management Plan

The following information should be provided as part of the drilling fluid management plan:

- Identify source of fresh water for mixing the drilling mud (Necessary approvals and permits are required for sources such as streams, rivers, ponds, or fire hydrants).
- Method of slurry containment.
- Method of recycling drilling fluid and spoils (if applicable).
- Method of transporting drilling fluids and spoils off site.

Drilling fluid pressures should not exceed that which can be supported by the overburden (soil) pressure. Drilling fluids serve many functions, as follows:

- Removes cuttings from the bottom of the hole and transports them to the surface.
- Holds cuttings and weight material in suspension when circulation is interrupted.
- Releases sands and cuttings at the surface.
- Stabilizes the hole with an impermeable cake.
- Cools and lubricates the drill bit and drill string
- Controls subsurface pressures.
- Transmits hydraulic horsepower.
- Cools the locating transmitter sonde preventing burnout.

Previous Experience

1. The permittee's contractor should provide a list of projects completed by his company, location, project environment (e.g., urban work, river crossing), product diameter and length of installation.
2. The permittee's contractor should provide a list of key personnel.

Safety

1. Emergency procedures for inadvertently boring into a natural gas line, live power cable, water main, sewer lines, or a fiber-optic cable, which comply with applicable regulations.
2. Emergency evacuation plan in case of an injury.

Contingency Plans

The Contingency plan shall address the containment and removal, of an inadvertent return or spill (e.g., drilling fluids, and hydraulic fluids).

Communication Plan

The communication plan should address the following:

1. The phone numbers for communication with owner or his representative on the site.
2. Identification of all key personnel which will be responsible for ensuring that the communications plan is followed.

Drilling Operations

The following paragraphs provide general remarks and rules of thumb related to the directional boring method, as well as specific details regarding various stages of the installation process.

1. The drill path alignment should be as straight as possible to minimize the fractional resistance during pullback and maximize the length of the pipe that can be installed during a single pull.
2. The radius of curvature is determined by the bending characteristics of the product line, and it is increasing with diameter.
3. If a drill hole beneath a road must be abandoned, the hole should be backfilled with grout or bentonite to prevent future subsidence.

Equipment Setup and Site layout

1. Sufficient space is required on the rig side to safely set up and operate the equipment.
2. Sufficient space should be allocated to fabricate the product pipeline into one string, thus enabling the pull back to be conducted in a single continuous operation.

Drilling and Back-Reaming

1. Drilling mud shall be used during drilling and back reaming operations. Using exclusively water may cause collapse of the borehole in unconsolidated soils, while in clays, the use of water may cause swelling and subsequent jamming of the product.
2. Heaving may occur when attempting to back ream too large of a hole. This can be avoided by using several pre-reams to gradually enlarge the hole to the desired diameter.

3. The conduit must be sealed at both ends with a cap or a plug to prevent water, drilling fluids and other foreign materials from entering the pipe as it is being pulled back.
4. Pipe rollers, skates or other protective devices should be used to prevent damage to the pipe from the edges of the pit during pullback, eliminate ground drag or reduce pulling force and subsequently reduce the stress on the product.
5. The drilling mud in the annular region should not be removed after installation, but permitted to solidify and provide support for the pipe and neighboring soil.

BREAK-AWAY PULLING HEAD

Some utility companies require the use of breakaway swivels to limit the amount of force used when pulling HDPE products.

PROTECTIVE COATINGS

In an HDD installation, the product pipe may be exposed to extra abrasion during pullback. When installing a steel pipe, a form of coating which provides a corrosion barrier as well as an abrasion barrier is recommended during the operation, the coating should be well bonded and have a hard smooth surface to resist soil stresses and reduce friction, respectively. A recommended type of coating for steel pipes is mill applied Fusion Bonded Epoxy.

DRILLING FLUID - COLLECTION AND DISPOSAL PRACTICES

Drilling fluids, additives and their Material Safety Data Sheets (MSDS) shall be identified within the contractors submittal permit package.

1. Excess drilling fluids shall be contained within a lined pit or containment pound, until removed from the site.
2. When an area of contaminated ground is encountered, the slurry shall be tested for contamination and disposed of in a manner, which meets Local, State and/or Federal requirements.
3. Precautions shall be taken to keep drilling fluids out of the streets, manholes, sanitary and storm sewers, and other drainage systems, including streams and rivers.
4. The contractor shall make all diligent efforts to minimize the amount of drilling fluids and cuttings spilled during the drilling operation, and shall provide complete clean-up of all drilling mud overflows or spills.

SITE RESTORATION AND POST CONSTRUCTION EVALUATION

1. All surfaces affected by the work shall be restored to their pre-existing conditions.
2. The permittee/contractor shall provide a set of as-built drawings to include both alignment and profile. Drawings should be constructed from actual field readings. Raw data shall be submitted as part of the "As-Built" document. The contractor shall stipulate the tracking method used to ensure the data was captured.